



Australian Government

MARL013 Demonstrate basic knowledge of marine steam turbines and main boilers

Release: 1

MARL013 Demonstrate basic knowledge of marine steam turbines and main boilers

Modification History

Release 1. New unit of competency.

Application

This unit involves the knowledge required to operate and maintain main steam propulsion plant and associated control systems on a commercial vessel.

This unit applies to the work of Marine Engineering Watchkeepers on commercial vessels greater than 750 kW and forms part of the requirements for the Certificate of Competency Marine Engineer Watchkeeper issued by the Australian Maritime Safety Authority (AMSA).

No licensing, legislative or certification requirements apply to this unit at the time of publication.

Pre-requisite Unit

Not applicable.

Competency Field

L – Marine Engineering

Unit Sector

Not applicable.

Elements and Performance Criteria

Elements describe the essential outcomes.

Performance criteria describe the performance needed to demonstrate achievement of the element.

1 Interpret an energy balance diagram for a shipboard steam plant

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| 1.1 | Ideal theoretical thermodynamic cycle for the operation of a steam plant is outlined |
| 1.2 | Why actual expansion of steam through a turbine differs from ideal cycle is explained |
| 1.3 | Typical heat losses around a steam plant are identified |
| 1.4 | Effect of air preheating, feed heating and economisation upon energy balance of steam plant's thermodynamic cycle are explained |

	1.5	Typical heat (and/or mass) balance diagram for a ship's steam plant is interpreted
2 Explain construction and operation of marine high-pressure water boilers	2.1	Advantages of water tube boiler over fire tube boiler for shipboard applications are outlined
	2.2	Construction and operation of a 'D' type membrane furnace boiler with superheater, economiser and air pre-heater is explained
	2.3	External fittings required by Classification Society Rules on any large boiler are identified
	2.4	Internal fittings of a boiler's main steam drum are identified
	2.5	How automation is applied to boiler control is clarified
	2.6	Start up, operation and shut down of a main propulsion steam boiler is outlined
3 Explain construction and operation of a main propulsion steam plant	3.1	How common forms of blading and rotor construction are manufactured is clarified
	3.2	How casings of common marine steam turbines are fitted out is clarified
	3.3	Principles of thermodynamics are applied to explain expansion of steam in a typical marine turbine
	3.4	Importance of start up and warming-through procedures for a steam turbine set is conveyed
	3.5	Checks required during routine turbine operation are explained
	3.6	Safety devices for a steam turbine set are identified and normal emergency shut-down procedures are identified
	3.7	Operation of turbines under normal and emergency conditions is outlined
4 Explain auxiliary machinery required to support operation of main propulsion steam turbines and boilers	4.1	Construction and operation of different types of auxiliary machinery needed to support main propulsion steam turbines and boilers is outlined
	4.2	Construction and operation of steam and electric motor prime movers required for driving auxiliary machinery are outlined
5 Explain	5.1	Configuration and operating principles of different steam

	configuration and operating principles of different steam distribution systems used in steam-powered vessels		distribution systems is outlined
		5.2	Typical pressure reducing and pressure control valves suitable for steam service are outlined and illustrated
6	Explain operation principles of close feed systems used by boiler/turbine sets	6.1	Difference between an open and a closed feed system is clarified
		6.2	Closed feed system is outlined
		6.3	Pressure feed heaters are outlined
		6.4	Chemical injection equipment suitable for use on any ship's main feed system is explained
7	Explain feed and boiler water treatment	7.1	Recommended limits of characteristics for boiler water and recommended intervals at which tests are undertaken are clarified
		7.2	Reasons for treating boiler water are outlined
		7.3	Different types of hardness in water, their consequences if left untreated, and ways of minimising their effect are explained
		7.4	How corrosion within a boiler is minimised by treating boiler water is explained
		7.5	Causes and ways of avoiding carry-over and caustic embrittlement are explained
		7.6	Safety requirements for handling feedwater and boiler water treatment chemicals are explained
8	Explain transmission of power from the steam turbine main engine to the propeller	8.1	Why reduction gearing is required between steam turbines and propeller is clarified
		8.2	Generation of tooth form is outlined
		8.3	Double helical gearing and difference between single and double reduction gearing are explained
		8.4	Applications of epicyclic gearing are explained
		8.5	Function of flexible couplings in a turbine/gearing set is clarified

	8.6	Components of a driveline from main wheel connection, aft, to propeller are listed
	8.7	Methods and mechanisms for lubricating a driveline are detailed
9 Explain procedures for preventing and responding to fires and explosions specific to steam propulsion plant	9.1	Causes, symptoms and means of preventing and extinguishing fires associated with steam propulsion plant are detailed
	9.2	Protective devices associated with boilers to minimise risk of fires, explosions and water shortages are identified
	9.3	Routine inspection and maintenance requirements to prevent fires, explosions and water shortages are outlined

Foundation Skills

Foundation skills essential to performance are explicit in the performance criteria of this unit of competency.

Range of Conditions

Range is restricted to essential operating conditions and any other variables essential to the work environment.

Marine steam turbines include one of the following:

- impulse
- reaction

Warming-through procedures include one or more of the following:

- ensuring air vent is open
- minimising thermal shock
- warming up according to manufacturer instructions
- shutting down

Safety devices include one or more of the following:

- axial movement
- gland temperature
- lube oil pressure
- lube oil temperature
- remote stops
- vacuum condenser pressure

- Auxiliary machinery includes one or more of the following:
- vibration
 - lube oil supply pump and system
 - main boiler forced draught fan
 - main condensate extraction pump and air ejector
 - main condenser
 - main cooling water circulating pump
 - main fuel oil supply pump and system
 - main feed pump
- Steam distribution systems include one or more of the following:
- auxiliary exhaust steam range
 - auxiliary superheated steam range
 - bled steam systems
 - superheated main steam range
- Fires include one or more of the following:
- blow back
 - economiser
 - explosions
 - low water level
 - uptake

Unit Mapping Information

This unit replaces and is equivalent to MARL5010A Demonstrate basic knowledge of marine steam turbines and main boilers.

Links

Companion Volume implementation guides are found in VETNet -
<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>

Assessment Requirements for MARL013 Demonstrate basic knowledge of marine steam turbines and main boilers

Modification History

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Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- accessing diagnostic information related to marine steam turbines
- applying relevant work health and safety/occupational health and safety (WHS/OHS) requirements and work practices
- assessing own work outcomes and maintaining knowledge of current codes, standards, regulations and industry practices
- identifying and applying relevant solutions to problems that can occur when operating steam propulsion plant and associated systems on a steam vessel
- identifying and interpreting diagnostic information, and performing mathematical calculations related to operating, repairing and maintaining marine steam turbines
- identifying methods, procedures and materials needed for operating, maintaining and repairing marine steam turbines
- providing accurate and reliable information
- providing appropriate level of detail in responses
- reading and interpreting manuals, technical specifications, safety data sheets/material safety data sheets and manufacturer guides related to operating, maintaining and repairing marine steam turbines.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- basic principles of operation of main steam propulsion and auxiliary systems on a steam vessel, including:
 - methods of turbine control, including safety devices
 - symptoms, causes, effects, and actions to be taken with defects of auxiliary steam turbines
 - construction and operation of main and auxiliary steam turbines
 - procedures for emergency operation of a steam turbine
- effective verbal, written and visual communication strategies
- established engineering practice and procedures for operating shipboard steam propulsion plant and associated systems in warm-through, manoeuvring, start up, normal running, emergency and shut down situations
- fundamental principles of steam propulsion systems and boilers
- hazards and problems that can occur when operating steam propulsion plant and associated systems, and appropriate preventative and remedial action
- methods of lubricating the principal components of a marine steam propulsion turbine and its associated gearing, and evaluating common faults, including common lubrication faults, symptoms, causes, and actions to be taken with such faults
- operational characteristics and performance specifications for different types of steam propulsion plant and associated systems on a steam vessel of unlimited propulsion power
- procedures for reading, interpretation of readings and indications of the performance of steam propulsion plant and associated systems
- typical operating precautions for steam propulsion plant and associated systems to ensure operational performance is in compliance with bridge orders, technical specifications, survey requirements and established safety and anti-pollution rules and regulations
- types, properties, tests, applications and treatment of fuels, lubricants, and solvents/chemicals used onboard a steam vessel, including a basic understanding of the working principles, construction, maintenance and safe operation of centrifuges, filters, and other treatment devices
- units of measurement
- WHS/OHS legislation and policies.

Assessment Conditions

Assessors must satisfy National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) assessor requirements.

Assessment must satisfy the National Vocational Education and Training Regulator (NVR)/Australian Quality Training Framework (AQTF) standards.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Assessment must occur in workplace operational situations or where these are not available, in simulated workplace operational situations or an industry-approved marine operations site that replicates workplace conditions where basic knowledge of marine steam turbines and main boilers can be demonstrated.

Resources for assessment include access to:

- diagrams, specifications and other information required for performing basic calculations related to marine steam turbines
- relevant documentation including workplace procedures, regulations, codes of practice and operation manuals
- technical reference library with current publications on basic marine steam turbines
- tools, equipment and personal protective equipment currently used in industry.

Performance should be demonstrated consistently over time and in a suitable range of contexts.

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<https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=772efb7b-4cce-47fe-9bbd-ee3b1d1eb4c2>